

# UTAH HOME ORCHARD PEST MANAGEMENT GUIDE

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# COMPONENTS OF A SUCCESSFUL PEST MANAGEMENT PROGRAM

Integrated pest management (IPM) is the practice of combining knowledge of the pest and host plant with multiple tactics for long-term, safe pest control. The goal of IPM is pesticide reduction by using cultural, mechanical, and biological controls before the last option, pesticides. When pesticides are necessary, use the least toxic options first. Aim to prevent environmental degradation and preserve natural enemies. Following the components of an IPM program will allow for the harvest of a healthy crop.

## Identifying Pests

Before deciding to implement any control measures, identify the pest (insect, mite or disease), and determine if it is serious enough to warrant control. Refer to the section on pest biology (page 26) for descriptions and pictures that will help you identify many of the common pests found in home orchards. Local Utah State University Extension county offices have more information on orchard pests and can help with pest identification, when to treat, and methods for control.

## Looking for Pests and Injury

One of the most important features of a successful pest management program is to look for pests and damage symptoms on a regular basis in your home orchard trees (scouting). Check fruit trees at least every two weeks during the growing season for signs of pests and pest damage. There are a variety of methods to scout for pests, from visual observation, to using traps.

### Scouting-Visual Observation

At least every two weeks:

- Pick a few leaves on each side of the tree to check for insect and disease damage; look on the undersides of leaves where insects and mites usually live; using a hand lens (10x to 20x) will help to better view the insects.
- Look at tree health in general: wilting foliage, yellowing foliage, slowed growth
- Check the trunk for injury, oozing sap, or migrating insects
- Observe fruit for scars or insect entry holes
- Shake a branch over a large piece of paper, cardboard, or cloth tray, and observe the fallen insects

### Scouting-Insect Traps

**Pheromone Traps:** If you have apple, pear, and/or peach trees and want to more precisely determine codling moth and peach twig borer activity and population size, consider hanging an insect pheromone trap (see suppliers of IPM products on page 37). Pheromones are chemicals that insects use to communicate with one another. The pheromones used in these traps are synthesized species-specific female sex pheromones. The males that are attracted to the trap get stuck on the sticky liner. The traps are helpful in determining the proper time to apply control sprays.

**Generic Sticky Traps:** You can also hang yellow or blue sticky cards in your trees to look for fruit fly, aphids, and thrips.

## Determining Whether to Treat

Another important component of an IPM program is knowing the appropriate pest population level at which to apply a pesticide. Some pests on home fruit trees can be ignored if their levels are too low to justify the costs involved in control. More time can be invested in cultural and sanitation practices. On the other hand, if fruit trees are in the vicinity of a commercial orchard, some quarantine pests, such as western cherry fruit fly and plum curculio, are pests that should be controlled. An outbreak of one of these pests in a commercial orchard can be devastating.

## Identifying When to Control

Insects and plant pathogens develop through various life stages (larva to moth, or mycelium to mushroom, for example). Some life stages are more vulnerable to treatment than others. Sometimes damage is visible but the opportune time to treat has already passed.

- For insects, the immature life stages are easiest to treat (for example, control should target newly hatched insects)
- Since most diseases are controlled with preventive measures, fungicides are applied before infection occurs (for example, new leaves must be protected against powdery mildew)

The most effective and economical way to avoid many pest problems is to provide an environment that discourages pests or reduces the tree's susceptibility to damage. These types of methods include proper planting, adjustments in cultural practices, and promoting beneficial insects. For pests that directly attack the fruit or trunks of trees, exclusion pesticides are the most reliable pest control option.

## Planting and Site Selection

- Select tree varieties or rootstocks with known insect tolerance or disease resistance; for example: Empire apple is tolerant of fire blight, and Malling Merton rootstocks are somewhat resistant to woolly apple aphid
- Know the hardiness zone, and choose varieties that are locally adapted; winter damage resulting in bark cracking can cause a tree to be more susceptible to attack by many diseases and insects
- Plant trees at root-collar depth, and in an optimal site; instead of letting the turf grow around the trees and compete for water and nutrients, apply a mulch around the base of trees, but keep it away from the trunk

## Soils and Nutrition

- Apply an amendment to the soil surface, such as manure or compost, in late fall to improve soil structure and quality
- Fertilization can assist with optimal tree growth, but is generally not necessary if your soil is healthy; test soils every other year
- If tree growth is slow (less than approx. 6 inches/year), apply a balanced fertilizer in the spring between pre-budbreak and bloom; do not over-fertilize, as this can lead to excessive, lush growth that is attractive to aphids, pear psylla, and other foliage pests
- Improve soil drainage by aerating compacted soil, adding amendments, grading, or adding drain tiles
- The most common nutrient deficiencies in Utah fruit trees are iron and zinc; these elements occur in the soil but are not available for uptake due to Utah's alkaline soils
- Iron deficiency is best prevented by a soil application of chelated iron (in the form of EDDHMA) every spring before budbreak

## Water Management

Mismanagement of water is a major contributing factor to many pest problems. Too little water can stunt growth of trees, reduce development of root systems, reduce fruit yields, and exacerbate the injurious effects of many pests. Severe water stress can cause leaves to drop and fruit to remain on trees after harvest.

Excessive watering can kill roots by depriving them of oxygen and increases the possibility of infection by soil-borne diseases, particularly Phytophthora crown rot. Over-watering is by far more common in Utah than under-watering.

For optimal watering, allow surface soil to dry out before irrigating. Flood or furrow irrigation may discourage ground squirrels and pocket gophers from digging burrows near tree trunks. Mini-sprinkler and drip irrigation are common in commercial orchards, and both can be adapted to residential sites. Overhead irrigation is wasteful and can lead to disease problems because leaves or fruit remain wet for extended periods.

## Ground Covers

When managed properly, orchard floor vegetation can have a positive effect on pest problems. Orchards with ground covers may have higher populations of certain natural enemies, largely due to increased habitat and alternate food sources for beneficial insects and mites; they also may have fewer problems with mites because of reduced dust. A hardy grass mixture of perennial ryegrass plus red fescue or a tall fescue can be planted to compete with weeds and minimize dust problems. Thick ground covers have also been shown to decrease pupation success of western cherry fruit fly.

If not properly managed, a ground cover can potentially be a source of pests. Rodent, crown rot, ant, stink bug and lygus bug problems have been associated with ground covers that get too overgrown or thick. Clovers, alfalfa, and many broadleaf weeds attract lygus and stink bugs insects that cause "cat-facing" damage (scarring and marking) to the exterior of fruits.

## Pest Control

### Sanitation

Many pests can overwinter and survive inside fruit, other tree parts, and debris. Keeping a clean orchard environment can greatly reduce the pest population:

- Gather fallen fruit and fruit remaining on trees after harvest and destroy, or till under
- Remove fruit that falls before harvest immediately since they may contain insect larvae
- Rake up dead leaves, especially cherry leaves, on which the powdery mildew fungus overwinters
- Prune and destroy dead and injured twigs or branches
- Remove wood piles or other debris where codling moth larvae may find shelter for the winter

### Fruit Bagging for Codling Moth

To exclude codling moth, place small paper bags over developing fruits. Bags should be well secured, but not constrict the twig. Wait to apply bags until the fruit is approximately  $\frac{1}{2}$  to  $\frac{3}{4}$  inch in diameter. Cut a small slit in the bag bottom, slip the slit over the fruit, and close the bag opening with a twist-tie. Remove the bags a short time before the fruit is mature to allow the fruit to color.

#### Types of barriers:

- Japanese 2-ply apple bags
- Sandwich bags of waxed paper or clear plastic
- White or tan paper sacks; may need to be replaced after rain
- Clear poly bags with drawstring closures
- Disposable nylon foot socks; easy to put on, but less effective with codling moth

### Biological Control

Predators, parasites, and pathogens of pest species can occur naturally in fruit orchards or may be purchased from commercial suppliers and released for supplementary control of pests (see list of suppliers on [page 37](#)).

Most biological control occurs naturally. Often its importance is not appreciated until a broad spectrum pesticide is applied, killing beneficial insects as well as the targeted pest. As a result, a different pest—suddenly not controlled by natural enemies—becomes a problem.

There are several things that can be done to encourage the activities of biological control agents already present in an orchard:

- Avoid the use of broad spectrum and more toxic pesticides unless necessary
- Provide a habitat that is more favorable for biological control agents by choosing adjacent plants that supply nectar, pollen, alternate hosts, and habitat for natural enemies (see [Ground Covers](#) section)
- Provide adequate organic content in the soil to help build the population of beneficial soil micro-organisms; although the mechanisms are little understood, these bacteria and fungi compete with soil pathogens

Most commercially available biological control agents are used in greenhouses, but there are a few other options for orchards. Predatory mites have been successfully mass released for control of plant-feeding spider mites in orchards. *Steinernema* and *Heterorhabditis* nematodes, which parasitize insects, show great promise for use against certain boring insects, soil dwelling insects, or insects in other types of moist, confined habitats. Release of *Trichogramma* wasps for control of numerous caterpillars, and release of lacewings for aphids and other small insects have potential, but results have been mixed because of variation in the quality of agents available and lack of reliable release procedures.

### Mass Trapping for Codling Moth

A mixture of molasses and yeast (1 part molasses: 10 parts water, plus  $\frac{1}{4}$  package dry yeast) can be placed in a plastic tub or small bucket, and hung in apple and pear trees to catch adult codling moths. This bait is attractive to both sexes. It can help reduce local populations of codling moths in your backyard trees, and may help reduce worm damage to fruit, but it likely will not completely eliminate damage. This method works best in areas with low codling moth populations.

### Pheromones

The pheromone monitoring trap described on [page 3](#) is not an effective pest control tool because only the male insect is attracted and caught. Multiple pheromone traps placed together in a tree can conflict with each other and actually catch fewer male moths than a single trap.

There is a method of using many release points of pheromones to control insects that is called *mating disruption*. Pheromones, enclosed in a dispensing device (twist tie, foil packet), are placed in fruit trees throughout the orchard. They control the targeted insect pest not by killing, but by releasing a high concentration of pheromone that disrupts males from locating females for mating. Hence, the females are never able to lay eggs. These products are not effective in home orchards because they require hundreds of release points in a uniform orchard of multiple acres of trees. Where only a few trees are involved, the pheromone concentration is too low, and mated female moths can fly in from nearby sources to lay fertile eggs on fruit.

## Pesticides

Any substance applied to control insects, fungi, weeds, or other pests is called a pesticide, whether it is organic or conventional. To avoid excessive pesticide use, choose alternative pest management options before relying on pesticides as the sole means of pest control. More pesticide products on the market today are compatible with an IPM program, and pose fewer risks to the environment.

- *Botanical* chemicals are derived from plant sources, and include pyrethrin, pyrethrum, neem oil, rotenone, and hot pepper wax
- *Microbial* pesticides are biological organisms or toxins derived from them; *Bacillus thuringiensis*

(Bt), a bacteria, is the classic example; it kills caterpillars and larvae by paralyzing the digestive system

- Other organic products include sulfur, diatomaceous earth, insecticidal soap, and oils; oil (horticultural oil, superior oil, narrow-range oil) is a particularly effective tool for safe control of soft-bodied insects and mites as well as some foliar diseases such as powdery mildew; with proper use, oil can be applied all season, not just during dormancy

## Using Pesticides Safely

Be aware that using a pesticide in any means other than that registered by the manufacturer is a violation of the law. A label is included with every pesticide—read it before using the product. It contains information on:

- Which plants it may be used on
- The rate at which it should be applied
- How to apply and what protective clothing to wear
- What to do in an emergency
- How to store it properly
- How long to wait before re-entering the treated area
- How long to wait between application and harvesting the fruit

Keep the label with the product so that this information is always on hand.

## COMMENTS ABOUT PESTICIDE RECOMMENDATIONS

This publication is not the final answer on which pesticides to use, how to use them, or when to apply them to fruit trees. The manufacturer's printed label must be the guide to formulations, timing, rates, the type of equipment and safety protection one needs, and the required interval from application to harvest.

This bulletin is a guide to the kinds of problems often experienced with insect and disease pests and the types of pesticides that are recommended for these problems.

Pesticide names in this guide are referred to by the chemical or active ingredient name, not the brand name. In some cases, the chemical and brand names are the same, such as malathion and Malathion, and in other cases they differ, such as carbaryl and Sevin. Chemical or active ingredient names of pesticide products are used in this bulletin, as there may be several brands of an acceptable product. A listing of active ingredient names and common brand names appears at the end of this bulletin.

The active ingredient is always shown on the front of a pesticide label. Note that there may be more than one active ingredient in a product. The concentration of the active ingredients will also be indicated, usually as a percentage. The brand name will usually indicate the formulation at the end of its name, for

example "Ferti-Lome Rose, Flower, and Vegetable Dust" (EC = emulsifiable concentrate; L = liquid; WP = wettable powder; granules; dusts).

This guide does not specify the formulations, concentrations, rates of application, or time to harvest allowed (pre-harvest interval) for most of the pesticides listed. There are too many variations of formulation, active ingredient concentration, and suppliers for it to be practical to list them all. Label directions must be followed explicitly to achieve the product's intended effects and margin of safe use. Also be aware that manufacturers frequently modify their labels and active ingredients in products. Refer to a USU Extension county agent or a reliable nursery or garden supplier for more detailed pesticide choice advice.

Note that the following products have been discontinued for use on tree fruits:

- chlorpyrifos (Dursban)
- diazinon
- dicofol (Kelthane)
- dimethoate (Cygon)
- endosulfan (Thiodan)
- phosmet (Imidan)

If previously purchased products with tree fruits on the label are owned, continue to use them according to their label.

## WAYS TO OBTAIN PEST MANAGEMENT INFORMATION

1. Home orchard insect and disease information and plant pest diagnostic assistance is available through the Utah State University Extension [Utah Pests](#) website.

2. Weekly tree fruit pest advisories for Utah are available during the growing season through the [Utah IPM](#) website.

3. Check a local newspaper for updated information on pest control from the local Extension agent, or visit his/her county office.

# FRUIT PEST CONTROL GUIDE

Refer first to General Orchard Management Practices section (page 3) for non-chemical options. For successful control of most pests, a combination of cultural and chemical methods is recommended. Pests are organized by tree species and growth stage. Refer to Tree Fruit Growth Stages section (page 21) for photos and names of tree development stages. Specific dates for timing of pest controls refer to optimal dates in northern Utah. For southern Utah, move dates earlier by 3 to 4 weeks.

## Apple

Pests	Target life stage / Timing	Materials / Protection interval
<b>Dormant</b>		
Fire blight	Prune limbs infected with cankers 12" below visible canker margins; spray trees just before budbreak	fixed copper or Bordeaux mixture°  Spraying upper fruit can cause russetting
<b>Green tip to half-inch green</b>		
Aphids (except woolly apple aphid) European red mite Scale Leafrollers	Overwinter as egg or immature stages on limbs; this is the most important spray to control these pests	dormant oil° alone or with malathion, permethrin, or gamma-cyhalothrin  Do not use oil below 40° or above 85°  Only one application required if coverage is good
<b>First Pink</b>		
Powdery mildew	Overwinters in buds and infects new leaves; protect susceptible varieties: Gala, Idared, Jonagold, Jonathan, and Rome (McIntosh and Golden and Red Delicious are mildly affected)	lime sulfur°  Sulfur must be reapplied every 7 to 10 days and may burn leaves, especially when temps. > 90°F  Sulfur causes fruit drop on Delicious varieties
<b>Bloom</b>		
Fire blight	When 4-day average temperatures are over 60°F and at least 2 hours of moisture occurs, bacteria may be spread to open flowers; protect susceptible varieties: Gala, Idared, Jonagold, Jonathon, Paula Red, Rome, Winter Banana, and Yellow Transparent	streptomycin  Repeat every 5 days during bloom if conditions are optimal for infection; read the label to ensure that apples are listed
<b>Petal Fall</b>		
White apple leafhopper	Nymphs feed on undersides of leaves; if population is high, treat before older nymphs (with long wing pads) are present	kaolin clay°, acetamiprid, imidacloprid, carbaryl, malathion, horticultural mineral oil°, or insecticidal soap°  One spray is adequate if timing is good
Aphids Lygus bug Stink bug	Aphid colonies begin to build at this time; lygus and stink bugs start entering the orchard to feed on developing fruit	insecticidal soap, neem oil, horticultural oil, imidacloprid, malathion, acetamiprid

°Organic products available

## Apple, continued

Pests	Target life stage / Timing	Materials / Protection intervals
<b>Fruit present</b>		
San Jose Scale	Look for limbs encrusted with small, circular, black and gray scales; place sticky tape traps (sticky side out) around infested limbs and monitor for activity of crawlers; the immature crawler stage will be active during late spring	carbaryl, malathion, pyrethrin, insecticidal soap°, gamma-cyhalothrin  Dormant oil sprays do not control this pest alone  One application timed with crawlers
Codling moth (worms) Leafrollers	Larvae hatch from eggs laid on and near fruits; start 10 days after petal fall or when the <a href="#">Utah IPM advisory</a> indicates to start	acetamiprid (14 days), gamma-cyhalothrin (14 days), carbaryl (7 days), spinosad° (7 days), codling moth virus° (7 days), malathion (5 to 7 days), pyrethrin° (5 to 7 days), azadirachtin (5 days), or Bt° (5 days)  Horticultural mineral oil° or kaolin clay° are suppressants only  Reapply based on protection intervals shown above (and see product labels) through first week of September  Mass trapping and fruit bagging (see <a href="#">page 5</a> )°
Aphids: Green apple aphid Rosy apple aphid Woolly apple aphid	Look for small, green or reddish purple insects inside curled leaves, or clumps of white “woolly” aphids on limbs; sticky honeydew is often present  Only treat if infestation is heavy, growth of young trees is being stunted, or black sooty mold is growing on fruit	insecticidal soap°, horticultural mineral oil°, imidacloprid, acetamiprid, azadirachtin°, or malathion  Many beneficial insects help suppress aphids, so avoid insecticides unless necessary
Spider mites	Most likely to become a problem during hot, dry conditions in July to September when mites reproduce rapidly; only treat if “leaf burn” is evident (look for russetting of leaves and small mites on undersides of leaves)	Wash tree down with stiff spray of water, or apply horticultural mineral oil° or insecticidal soap°  Predator mites commonly suppress spider mites, so avoid disruptive insecticides (e.g. pyrethroids)
Crown and root rot	A water mold, <i>Phytophthora</i> , causes cankers, wilt of leaves, and limb dieback in wet, poorly drained soils	phosphorous acid (as a foliar spray preventive)  Remove dead/dying tree(s); do not replant in the same location or plant trees too deep  For prevention, keep emitters of drip irrigation away from the trunk and do not keep trunk constantly wet
Tree and root borers	Flatheaded and roundheaded borers attack trunks and limbs while root borers tunnel in roots and crowns; when borer populations are known to be high in an area, prevent infestations in at-risk trees (young, stressed, or in decline) when adults are active in June and July	imidacloprid (systemic) or carbaryl  Apply imidacloprid as soil/root drench in spring; apply carbaryl to crown, trunk, and lower scaffolding limbs in mid-June  Only single application required if timing is good  Entomopathogenic nematodes or fungi may be effective for root borers

°Organic products available

## Pear

Pests	Target life stage / Timing	Materials / Protection interval
<b>Dormant</b>		
Pear psylla	Overwinter as adults outside the orchard and fly into pear trees about 6 weeks before bloom (March); treat if adults are detected before egg-laying begins	dormant oil <sup>o</sup> alone or with malathion, permethrin, bifenthrin, or gamma-cyhalothrin  Only 1 application if coverage is good
Fire blight	Prune limbs infected with cankers 12" below visible canker margins; spray trees just before bud break	fixed copper <sup>o</sup> or Bordeaux mixture <sup>o</sup>
<b>Bud Burst to tight cluster</b>		
Leaf blister mite Rust mite	Overwinter as adults under bud scales	dormant oil <sup>o</sup> alone or with carbaryl; sulfur (single application, do not mix oil and sulfur)
<b>Bloom</b>		
Fire blight	When rain occurs and average temperatures > 60°F, bacteria may be spread to open flowers	streptomycin  Repeat every 5 days during bloom, when conditions are optimal for infection
<b>Petal fall</b>		
Pear psylla	Only treat in lieu of the dormant spray, if adults are still active after petal fall, or if psylla injury was severe in the previous year	kaolin clay <sup>o</sup> , pyrethrin <sup>o</sup> , acetamiprid, bifenthrin, or gamma-cyhalothrin  Apply imidacloprid as soil/root drench
<b>Fruit present</b>		
Codling moth (worms) Leafrollers	Larvae hatch from eggs laid on and near fruits starting 10 days after petal fall or when the <a href="#">Utah IPM advisory</a> indicates to start (see <a href="#">Pest Biology</a> section for how to obtain codling moth trap catch and degree-day timing information)	acetamiprid (14 days), gamma-cyhalothrin (14 days), bifenthrin (14 days), carbaryl (7 days), spinosad (7 days), codling moth virus (7 days), malathion (5 to 7 days), pyrethrin (5 to 7 days), azadirachtin (5 days), or Bt (5 days)  Horticultural mineral oil <sup>o</sup> and kaolin clay <sup>o</sup> are suppressants only  Reapply based on protection intervals shown above (and see product labels) through first week of September; (also see mass trapping and fruit bagging <a href="#">page 5</a> )
Spider mites	Most likely to become a problem during hot, dry conditions in July to September when mites reproduce rapidly; pears are highly sensitive to "mite burn" where leaves turn dark brown to black quickly as mites feed on the undersides of leaves	Wash tree down with stiff spray of water, or apply horticultural mineral oil <sup>o</sup> or insecticidal soap <sup>o</sup>  Predator mites commonly suppress spider mites, so avoid disruptive insecticides (e.g. pyrethroids)
Pear sawfly (pear or cherry slug)	Larvae (slugs) feed on the upper epidermal layer of leaves causing skeletonizing; trees can tolerate low populations	spinosad <sup>o</sup> , malathion, carbaryl, or gamma-cyhalothrin  Single application is usually adequate
Leaf blister mite Rust mite	Look for russetting of fruit and leaves; treat before leaves drop and mites move to buds to spend the winter	carbaryl or sulfur <sup>o</sup>

<sup>o</sup>Organic products available

## Peach, Nectarine, and Plum

Pests	Target life stage / Timing	Materials / Protection interval
<b>Swollen bud to first pink</b>		
Peach twig borer Aphids Scale European red mite	Peach twig borer overwinters as young larvae in protected cells on twigs; the larvae emerge to feed on new growth  Aphids, red mite and scale overwinter as eggs or immatures on limbs; take advantage of their exposure at this time	dormant oil° alone or with permethrin, gamma-cyhalothrin, or malathion  For twig borer only, Bt° or spinosad° at pink, and then again at petal fall
<b>Petal fall</b>		
Cat-facing insects (lygus bug, stink bug)	Prevent piercing-sucking bugs from feeding on new fruit; treat only if cat-facing injury was a problem in the previous year or if high populations of bugs are observed now	permethrin, gamma-cyhalothrin, or malathion  Only one application needed if timing is good
<b>Shuck split</b>		
Shot hole (coryneum blight) (not plum)	Fungus overwinters in buds; protect new leaves and fruit at this time	chlorothalonil or captan  Do not use chlorothalonil after shuck split stage  Captan can be used for additional sprays as new infections can occur throughout the season when 6+ hr. of moisture occurs; captan should be used as preventive before moisture
Powdery mildew (not plum)	Treat when fruit is the size of a pea; can cause "peach rusty spot" on mildew-susceptible apple cultivars growing nearby	propiconazole, sulfur°, or horticultural mineral oil  Sulfur sprays must be repeated to be effective; may burn leaves on some varieties, especially when temperatures >90°F
Green peach aphid Plum aphid	Small pear-shaped insects curl leaves & produce sticky honeydew; best to control before leaves are tightly curled	insecticidal soap°, horticultural mineral oil°, azadirachtin°, malathion, or pyrethrin°  Many beneficial insects help suppress aphids, so avoid insecticides unless necessary
<b>Fruit present</b>		
Peach twig borer (worms) (not plum) in fruit	Larvae prefer to tunnel in new shoots and tender twigs; but later, larvae will tunnel into fruits (time fruit protective sprays according to the <a href="#">Utah IPM advisories</a> )	spinosad°, acetamiprid (14 days), carbaryl (14 days), gamma-cyhalothrin (14 days), malathion (7 days), pyrethrin (3 to 5 days), or Bt°  One or two sprays needed, dependent on pest pressure
Spider mites	Most likely to become a problem during hot, dry conditions in July to September when mites reproduce rapidly; only treat if "leaf burn" is evident (look for russeting of leaves and small mites on undersides of leaves)	Wash tree down with stiff spray of water, or apply horticultural mineral oil° or insecticidal soap°  Predator mites commonly suppress spider mites, so avoid disruptive insecticides

°Organic products available

## Peach, Nectarine, and Plum, continued

Pests	Target life stage / Timing	Materials / Protection interval
<b>Fruit present (continued)</b>		
Peach silver mite (not plum)	Mite feeding causes “silvering” of leaves; only treat if symptoms are severe	sulfur (single application)
Peachtree (crown) borer	Adults emerge in late June to early July, see <a href="#">Pest Biology</a> section for how to protect lower trunk and crown from larvae about the first week of July and again in early August	carbaryl, permethrin, or gamma-cyhalothrin  Two sprays needed: early July and early August
Walnut husk fly (not plum)	Larvae (maggots) feed within fruits; adults can be monitored with Pherocon AM® traps; treat by 7 days after first adult flies are caught or beginning in late July	spinosad°, carbaryl, malathion, pyrethrin°, or gamma-cyhalothrin  One or two sprays may be needed
Perennial (cytospora) canker/gummosis	Cankers develop on trunk and limbs; stressed and older trees are most at risk	Keep trees growing vigorously and prune out dead branches, especially those with cankers; there are no effective sprays
Shot hole (coryneum blight) (not plum)	To prevent spread, treat pre-harvest only if rain is frequent (at least 6 hr.)	captan  Apply before rain
Earwigs	Adults climb trees and feed in ripe fruit	Band tree trunk near base with sticky adhesive or spinosad bait°, or spray carbaryl on tree
European paper wasp	Protect ripe fruit from fruit-eating wasps	carbaryl, malathion, spinosad°  Follow pre-harvest interval on the label
<b>Post-harvest</b>		
Shot hole (coryneum blight) (not plum)	New infections occur in fall on fresh leaf scars; 50% leaf fall is the most important timing for good control and to protect overwintering buds	chlorothalonil, Bordeaux mixture, or fixed copper  Use high pressure spray to knock off remaining leaves and cover as many leaf scars as possible

°Organic products available

## Apricot

Pests	Target life stage / Timing	Materials / Protection interval
<b>Swollen bud to first white</b>		
Peach twig borer Aphids Scale European red mite	Peach twig borer overwinters as young larvae in protected cells on twigs; the larvae emerge to feed on new growth  Aphids, red mite, and scale overwinter as eggs or immatures on limbs; take advantage of their exposure at this time	dormant oil <sup>°</sup> alone or with permethrin, gamma-cyhalothrin or malathion  For twig borer only, Bt <sup>°</sup> or spinosad <sup>°</sup> at pink, and then again at petal fall
<b>Petal fall to shuck split</b>		
Shot hole (coryneum blight)	Fungus overwinters in buds; protect new leaves and fruit at this time	chlorothalonil or captan  Do not use chlorothalonil after shuck split stage  Captan can be used for additional sprays as new infections can occur throughout the season when 6+ hr. of moisture occurs; captan should be used as preventive before moisture
Cat-facing insects (lygus bug, stink bug)	Prevent piercing-sucking bugs from feeding on new fruit if cat-facing injury was a problem in the previous year or if high populations of bugs are observed now	permethrin, gamma-cyhalothrin or malathion  Only one application needed if timing is good
<b>Fruit present</b>		
Peach twig borer (worms)	Larvae prefer to tunnel in new shoots and tender twigs; but later, larvae will tunnel into fruits (time fruit protective sprays according to <a href="#">Utah IPM advisory information</a> )	spinosad <sup>°</sup> , carbaryl, malathion, Bt <sup>°</sup> , pyrethrin, gamma-cyhalothrin or pyrethrum <sup>°</sup>  One or two sprays needed, dependent on pest pressure
Peachtree (crown) borer	Adults emerge in late June to early July, see <a href="#">Pest Biology</a> section for how to protect lower trunk and crown from larvae about the first week of July and again in early August	carbaryl, permethrin, or gamma-cyhalothrin  Two sprays needed: early July and early August
Earwigs	Adults climb trees and feed in ripe fruit	Band tree trunk near base with sticky adhesive, spinosad bait <sup>°</sup> , or spray carbaryl on tree
European paper wasp	Protect ripe fruit from fruit-eating wasps	carbaryl, malathion, spinosad <sup>°</sup>  Follow pre-harvest interval on the label
<b>Post-harvest</b>		
Shot-hole (coryneum blight)	New infections occur in fall on fresh leaf scars; 50% leaf fall is the most important timing for good control and to protect overwintering buds	chlorothalonil, Bordeaux mixture, or fixed copper  Use high pressure spray to knock off remaining leaves and cover as many leaf scars as possible

<sup>°</sup> Organic products available

## Cherry (Sweet and Tart)

Pests	Target life stage / Timing	Materials / Protection interval
<b>Green tip to tight cluster</b>		
Aphids Scale	Overwinter as eggs or immatures on limbs; take advantage of their exposure at this time	dormant oil <sup>°</sup> alone or with malathion, permethrin, or gamma-cyhalothrin (single application)
<b>Petal fall</b>		
Black cherry aphid (sweet cherry only)	Cause severe leaf curling and produce abundant sticky honeydew; best to control before leaves are tightly curled	insecticidal soap <sup>°</sup> , horticultural mineral oil <sup>°</sup> , azadirachtin <sup>°</sup> , malathion, or gamma-cyhalothrin  Many beneficial insects help suppress aphids; avoid insecticides unless necessary
Powdery mildew	Spores overwinters on dead leaves and in cracks on trunk; protect new leaves as needed	propiconazole, potassium bicarbonate, or sulfur  Repeat throughout emergence of new leaves; sulfur may burn leaves, especially when temperatures >90°F
<b>Fruit present</b>		
Western cherry fruit fly Apple maggot	Larvae (maggots) feed within fruits; treat when fruits develop a rose blush color (see <a href="#">Pest Biology</a> section)	spinosad <sup>°</sup> (7 days), gamma-cyhalothrin (7 days), carbaryl (5 to 7 days), malathion (3 to 5 days), or pyrethrin <sup>°</sup> (3 to 5 days)  Reapply based on protection intervals noted above (and see product labels) through fruit harvest; carefully follow required interval between last spray and harvest (see product labels)
Perennial (cytospora) canker	Cankers develop on trunk and limbs; stressed and older trees are most at risk	Keep trees growing vigorously; prune out dead branches, especially those with cankers in late summer or early spring (when dry)  No effective sprays
Crown and root rots	A water mold, <i>Phytophthora</i> , causes cankers, wilt of leaves, and limb dieback in wet, poorly drained soils	phosphorous acid (as a foliar spray preventive)  Remove dead/dying tree(s); do not replant in the same location or plant trees too deep  Avoid excessive irrigation: don't allow trunk to be constantly wet and keep emitters of drip irrigation away from the trunk
Tree and root borers	Flatheaded and roundheaded borers attack trunks and limbs, while root borers tunnel in roots and crowns  Prevent infestations in at-risk trees (young, stressed, or in decline) when adults are active in June and July; only necessary when borer populations are known to be high in an area	imidacloprid (systemic), carbaryl, or permethrin  Apply imidacloprid as soil/root drench in spring; apply carbaryl to crown, trunk, and lower scaffolding limbs in mid-June  Only single application required if timing is good  Entomopathogenic nematodes or fungi may be effective for root borers

<sup>°</sup> Organic products available

## Cherry (Sweet and Tart), continued

Pests	Target life stage / Timing	Materials / Protection interval
<b>Fruit present (continued)</b>		
Spider mites	Most likely to become a problem during hot, dry conditions in July to September when mites reproduce rapidly; only treat if "leaf burn" is evident ( look for russetting of leaves and small mites on undersides of leaves)	Wash tree down with stiff spray of water, or apply horticultural mineral oil° or insecticidal soap°  Predator mites commonly suppress spider mites, so avoid disruptive insecticides (e.g., pyrethroids)
Pear sawfly (cherry or pear slug)	Slug-looking larvae feed on the upper epidermal layer of leaves causing skeletonizing; trees can tolerate low populations	spinosad°, malathion, or carbaryl  One application should suffice

°Organic products available

## Walnut and Pecan

Pests	Target life stage / Timing	Materials / Protection interval
<b>Spring</b>		
Aphids	Treat when aphid numbers > ~ 15 per leaf	insecticidal soap°, horticultural mineral oil°, azadirachtin°, or malathion
<b>Summer</b>		
Spider mites	Most likely to become a problem during hot, dry conditions in July to September when mites reproduce rapidly; only treat if "leaf burn" is evident (look for russetting of leaves and small mites on undersides of leaves)	Wash tree down with stiff spray of water, or apply horticultural mineral oil° or insecticidal soap°  Predator mites commonly suppress spider mites; avoid broad spectrum insecticides
Walnut husk fly	Larvae (maggots) feed within walnut husks; treat about August 1 and 15	spinosad°, carbaryl, malathion or pyrethrin°  One or two sprays may be needed

°Organic products available

## Grape

Pests	Target life stage / Timing	Materials / Protection interval
<b>Spring</b>		
Powdery mildew	Fungus infects new leaves; treat when new shoots are 6 inches long and again at 12 and 18 inches long	sulfur (do not use at temperatures above 90°F)
<b>Spring to summer</b>		
Leafhoppers	Nymphs feed on undersides of leaves; if population is high, treat before older nymphs (with long wing pads) are present as adults (winged) are difficult to kill with insecticides	kaolin clay°, carbaryl, malathion, horticultural mineral oil°, or insecticidal soap°  Apply two applications 1 to 2 weeks apart
Western grape leaf skeletonizer	Pest only known from St. George area; look for larvae on leaves and treat only if pest is detected	spinosad° or carbaryl
European paper wasp	Protect ripe fruit from fruit-eating wasps	carbaryl, malathion, or spinosad°  Follow pre-harvest interval on the label

°Organic products available

## Raspberry and Blackberry

Pests	Target life stage / Timing	Materials / Protection interval
<b>Before bud break</b>		
Powdery mildew (uncommon)	Protect new buds from overwintered fungus	sulfur (do not use during warm temperatures as it can burn the buds)
<b>Bud break to pre-bloom</b>		
Raspberry horntail	Adult female wasps insert eggs under epidermis of canes, beginning before bloom ( about late May in northern Utah); hatched larvae tunnel up the canes and cause wilted cane tips  Protect canes from egg-laying females	carbaryl, acetamiprid, malathion, azadirachtin <sup>o</sup> , or kaolin clay <sup>o</sup>  Protect pollinators by avoiding sprays during bloom and by pruning out wilted cane tips during June to August; consistent and frequent pruning can be effective
<b>Post-bloom</b>		
Rose stem girdler	Female beetle lays eggs on canes and the larva chews through bottom of the egg and into the cane; it tunnels in a spiral pattern within the cambium and girdles the cane causing a swollen gall  Protect canes from egg-laying females	carbaryl, acetamiprid, azadirachtin <sup>o</sup> , or malathion  Protect pollinators by avoiding bloom sprays and prune out girdled canes during June to August; consistent pruning can be effective
Earwigs	Adults climb plants and feed on ripe fruits	carbaryl, azadirachtin <sup>o</sup> , or malathion  Band cane base with sticky adhesive and dislodge earwigs by shaking canes vigorously
Spider mites	Most likely to become a problem during hot, dry summer weather when mites reproduce rapidly; only treat if "leaf burn" is evident (look for russetting of leaves and small mites on undersides of leaves)	Wash plants down with stiff spray of water, or apply horticultural mineral oil <sup>o</sup> or insecticidal soap <sup>o</sup>  Predator mites commonly suppress spider mites; avoid insecticides unless necessary
Powdery mildew (uncommon)	When mildew growth appears on leaves  The Logan raspberry is immune to powdery mildew	Apply neem oil or fixed copper every 10 to 14 days in the morning or evening to avoid high temperatures  Use potassium bicarbonate for raspberry varieties Chief, Marcy, and Malling Orion
Raspberry crown borer	Female clearwing moths lay eggs on undersides of leaves in late summer to early fall; larvae crawl down the outside of canes and tunnel into lower canes and crowns to spend the winter  Target larvae for control in late September to mid-October in northern Utah	carbaryl, malathion, bifenthrin, or azadirachtin <sup>o</sup>  Spray lower canes and drench around base of plants; dig out infested canes and dispose
Root and crown rot	Most likely to become a problem in poorly drained soils during periods of heavy irrigation	Phosphorous acid foliar spray for preventive protection; apply prior to initiation of heavy irrigation periods; a second application may be applied 3 to 4 weeks later if needed  Do not replant in the same location and keep emitters of drip irrigation away from canes
European paper wasp	Protect ripe fruit from fruit-eating wasps	bifenthrin, carbaryl, malathion, spinosad <sup>o</sup>  Follow pre-harvest interval on the label

<sup>o</sup> Organic

## Strawberry

Pests	Target life stage / Timing	Materials / Protection interval
<b>Pre-bloom</b>		
Leafrollers	Larvae roll up leaves with silk and hide inside; larvae chew on leaves	spinosad <sup>°</sup> , Bt <sup>°</sup> , azadirachtin, carbaryl, or malathion  Single application if timing is good
Root weevils	Adults chew notches into leaf edges while larvae chew into roots; treat during late spring and early summer when injury appears	spinosad <sup>°</sup> , carbaryl, malathion, or imidacloprid  Apply entomopathogenic nematodes or fungus to soil at roots
<b>Bloom</b>		
Blossom blight	During wet conditions, begin treating at first bloom to prevent fungal infection of flowers	captan  Remove infected blossoms to reduce inoculum  Repeat at spray interval recommended on product label
<b>Post-bloom</b>		
Powdery mildew	When mildew growth appears on leaves	sulfur, fixed copper, Bordeaux mixture, or neem oil  Apply every 10 to 14 days, mornings or evenings throughout growing season
Gray mold	During wet conditions, look for gray cottony mold growth on leaves and fruit	captan or fixed copper  Repeat applications as needed
Spider mites	Most likely to become a problem following hot, dry conditions in summer when mites reproduce rapidly; only treat if "leaf burn" is evident (look for russetting of leaves and small mites on undersides of leaves)	Wash plants down with stiff spray of water, or apply horticultural mineral oil <sup>°</sup> or insecticidal soap <sup>°</sup>  Predator mites commonly suppress spider mites; avoid disruptive insecticides
Root and crown rot	Most likely to become a problem in poorly drained soils during periods of heavy irrigation	phosphorous acid spray for preventive protection; apply prior to initiation of heavy irrigation periods; a second application may be applied 3 to 4 weeks later if needed  Do not replant strawberries in same location  Plant on raised bed for better drainage

<sup>°</sup> Organic

## FUNGICIDE EFFICACY

This table is intended as a guide to select the most effective fungicides for management of fruit tree fungal diseases.

1 = poor efficacy, 2 = fair efficacy, 3 = good efficacy, 4 = excellent efficacy, and ---- = not registered for this fungal disease or crop site

Fungicide	Powdery Mildew	Fire Blight	Shothole	Blossom Blight
Bordeaux mixture	----	3	----	----
captan	----	----	3	----
chlorothalonil	----	----	2	2
fixed copper	----	2	3	----
horticultural mineral oil	2	----	----	----
myclobutanil (Spectracide)	4	----	----	----
neem oil (Trilogy)	2	----	1	2
potassium bicarbonate (Bonide)	2	----	----	----
propiconazole (not on apple)	3	----	----	----
streptomycin	----	4	----	----
sulfur	3	----	----	1

## INSECTICIDE EFFICACY

This table is intended as a guide to select the most effective insecticides for management of fruit insect and mite pests.

1 = poor efficacy, 2 = fair efficacy, 3 = good efficacy, 4 = excellent efficacy, and --- = not registered for this arthropod pest or crop site

Insecticide	Aph	Cat	Cod	Lbm	Lfh	Ptb	Pps	Ptr	Rcb	Rht	Rtw	Rsg	Sca	Spm	Wcf
acetamiprid	2-3	---	3-4	---	3	---	3	---	1	3	---	3	3	1	---
azadirachtin	2-3	1	1-2	---	1-2	1-2	1	---	1-2	1-2	1-2	1-2	1	---	1
Bacillus thuringiensis	---	---	1-2	---	---	2-3	---	---	---	---	---	---	---	---	---
bifenthrin (pear and cane berries only)	3	2	3	---	3	---	3-4	---	3-4	---	---	---	3	---	---
carbaryl	1-2	1-2	3	2-3	4	3	1	3	3	3	2-3	3	2-3	---	2-3
codling moth virus	---	---	3	---	---	---	---	---	---	---	---	---	---	---	---
entomopathogenic nematodes and fungus	---	---	1-2*	---	---	---	---	1-2*	1-2*	---	3*	---	---	---	---
fenbutatin-oxide	---	---	---	---	---	---	---	---	---	---	---	---	---	2-3	---
gamma-cyhalothrin	3-4	3-4	2-3	1	3	3	3	3	---	---	---	---	3	1	3
horticultural mineral oil	2-3	---	2-3†	2	3	1	1-2	---	---	---	---	---	1-2	2-3	---
imidacloprid <sup>a</sup>	3-4	---	---	---	4	---	3-4	---	---	---	---	---	---	---	---
insecticidal soap	2-3	---	---	---	2-3	---	---	---	---	---	---	---	---	2	---
kaolin clay	---	1-2	2	---	2-3	---	3-4	---	---	---	---	---	---	1-2	---
malathion	3	2-3	2-3	---	2-3	2-3	1	---	2-3	2-3	2-3	2-3	2-3	1-2	2-3
permethrin <sup>*</sup>	3	3	---	---	---	3	3	3	---	---	---	---	3	---	3
pyrethrin and pyrethrum	2-3	2	1-2	---	2	2	2	1	1-2	1-2	1-2	1-2	2	---	2
spinosad	---	---	2-3	---	---	3	---	---	1-2	1-2	1-2	1-2	---	---	3-4
sulfur	---	---	---	3-4	---	---	---	---	---	---	---	---	---	1-2	---

Aph = Aphids, Cat = Cat-facing insects, Cod = Codling moth and leafrollers, Lbm = Leaf blister, rust and peach sliver mites, Lfh = Leafhoppers, Ptb = Peach twig borer, Pps = Pear psylla, Ptr = Peachtree borer, Rcb = Raspberry crown borer, Rht = Raspberry horntail, Rtw = Root weevils, Rsg = Rose stem girdler, Sca = Scale insects, Spm = Spider mites, and Wcf = Western cherry fruit fly, apple maggot, and walnut husk fly

\*If applied to the trunk, crown, or soil, nematodes and fungus can kill larvae (see [Pest Biology](#) section for information on specific application site for each insect pest type). Activity will be short-lived as nematodes and fungus will die once they desiccate.

†Oil will suffocate codling moth eggs. Apply during peak egg-laying periods.

<sup>a</sup>Imidacloprid is only registered for use on apple and pear (and pome fruit relatives) and for application by soil drench.

<sup>\*</sup>Permethrin is registered for pre-bloom applications only, except for some stone fruits (read label carefully).

## TOXICITY OF PESTICIDES TO NATURAL ENEMIES AND POLLINATORS

This table is intended as a guide to the relative toxicity of orchard pesticides to beneficial arthropods (predators) and pollinators.

Whenever possible, select pesticides with the lowest toxicities: L = Low, M = Moderate, and H = High.

Pesticide	Aphid Predators		Mite Predators		Honey Bee	Comments
	Lady Beetles	Lacewings	Stethorus Lady Beetle	Predatory Mites		
acetamiprid	M	M-H	M	L	M	
azadirachtin	L	L	L	L	L	Organic formulations available
Bacillus thuringiensis (Bt)	L	L	L	L	L	Non-toxic except to caterpillars; organic
bifenthrin	H	H	H	M-H	H	Can flare spider mites
carbaryl	H	M	H	H	H	Best if used early-season or post-harvest to avoid killing beneficials
codling moth virus	L	L	L	L	L	Non-toxic except to codling moth; organic
entomopathogenic nematodes and fungi	L	L	L	L	L	Non-toxic except to soil-dwelling insects or those living in moist environments; organic
gamma-cyhalothrin	H	H	H	M-H	H	Can flare spider mites
horticultural mineral oil	L	L	L	L-M	L	Rate, spray volume, and coverage determine toxicity to pests and beneficials; negative effects are reduced due to short residual
imidacloprid	M	M-H	M	L	M	Apply as a soil drench only; avoid contact with beneficials
insecticidal soap	L	L	L	M	L	Organic
kaolin clay	M-H	M-H	M-H	M-H	L	Best if used early-season to avoid killing beneficials; organic
malathion	L-M	L	L-M	L-M	M	
permethrin (peach and pear only)	L-M	L-M	H	H	M-H	Use only in early-season to avoid killing beneficials
pyrethrin and pyrethrum	L	L	L	L	L	Organic formulations available
spinosad	L	M-H	L	L	L	Organic formulations available; fresh residues (<3 hr) are toxic to bees
sulfur	L	L	L	M-H	L	Organic

# TREE FRUIT GROWTH STAGES

Note: Typical stage names are shown, with alternative names in parentheses.

## Apple



Dormant



Silver Tip



Green Tip



Half-inch Green



Tight Cluster



First Pink (Pink)



Open Cluster (Full Pink)



First Bloom (King Bloom, King Blossom)



Full Bloom



Post-bloom

# Pear



Dormant



Swollen Bud (Bud Swell, Scales Separating)



Bud Burst (Blossom Buds Exposed)



Green Cluster (Tight Cluster)



White Bud (Popcorn, First White)



Full White



First Bloom (King Blossom)



Full Bloom



Petal Fall (Post Bloom)

Mark Longstroth, Michigan State University

## Peach and Nectarine



Dormant



Swollen Bud (First Swelling)



Quarter-inch Green (Calyx Red)



Pink (First Pink)



First Bloom



Full Bloom



Post Bloom (Petal Fall)



Shuck Split

## Plum



Swollen Bud



Bud Burst



White Bud



Bloom



Petal Fall

## Apricot



Swollen Bud (Bud Swell)



First Bloom



Full Bloom



Petal Fall



In the Shuck



Shuck Split

## Cherry (Sweet and Tart)



Dormant



Swollen Bud (Bud Swell, First Swelling)



Green Tip (Bud Burst)



Tight Cluster (Early White Bud)



White Bud (First White, Popcorn)



First Bloom



Full Bloom



Petal Fall (Post Bloom)

Mark Longstroth, Michigan State University

## Diseases

(listed in alphabetical order)

### Apple Mosaic Virus

*Hosts:* apple, stone fruits, strawberry



Apple mosaic virus is spread only by grafting of diseased scion (buds, twigs, or roots) onto healthy stock. As such, it is not very common, and can easily be prevented. Infected trees are slow growing and produce low fruit yields. Leaves

develop a distinctive, random pattern of chlorotic (yellow) tissue.

*Management:* Plant virus-free varieties, and use virus-free grafting scion. Diseased trees do not need to be removed, but should not be used as a source for scion material.

### Apple Scab

*Hosts:* apple, pear (rare)

This fungal disease has been seen sporadically in Utah, as it favors cool, wet conditions. Scab symptoms include dark lesions on leaves, puckered and twisted leaves, premature leaf drop, and black, scabby lesions on fruit.

*Management:* Rake and remove all leaves in fall and during the growing season. Prevent irrigation water from wetting leaves. Plant scab-resistant apple varieties. Fungicides are usually not necessary in home orchards.

### Bitter Pit

*Hosts:* apple

Bitter pit is a disorder of apple fruit caused by a deficiency of calcium, and is usually seen after harvest. Granny Smith, Jonathan, and Golden Delicious are a few susceptible varieties. Affected apples will have sunken lesions on the skin, with brown, spongy tissue underneath.

*Management:* Do not over-fertilize or over-prune, as vigorous trees can be more susceptible.

### Blossom Blight

*Hosts:* grapes, stone fruits, and strawberry

Blossom blight is an infection of blossoms caused by various fungi including *Botrytis* on strawberries, and *Botrytis* and *Monilinia* (brown rot) on stone fruits. Brown rot is not yet documented in Utah. It affects the fruit with dark discolorations and rotting. Blackened fruit “mummies” will remain on the tree. See also gray mold.

*Management:* Maintain good air circulation within and between plants. Remove and destroy all blighted plant tissue and fruit “mummies.” Do not over-water or leave standing water on foliage. Keep plants well fertilized.

### Coryneum Blight (Shot-hole Blight)

*Hosts:* peach, nectarine, apricot, tart and sweet cherry (rare)



This is a common fungal disease in Utah. It attacks dormant leaf buds, blossom buds, leaves, fruit, and twigs. The first visible lesions occur on young leaves as small, round, purplish-black spots. Eventually these infections fall out, leaving round holes, and giving this disease its name. Circular lesions later develop on fruit that first appear as reddish spots, and later as rough, corky bumps. Sometimes they are sunken. On peaches, affected buds may die and appear to be “varnished” due to gummosis. Infections may girdle twigs.

*Management:* Prune and destroy all infected plant tissue. Prevent irrigation water from wetting leaves. For severe infections, apply copper spray in fall starting at 50% leaf drop to protect newly forming buds, and use chlorothalonil 1 to 2 times before shuck split stage.

## Crown Rot and Root Rot

*Hosts:* all fruit trees



Caused by soil-borne, fungus-like organisms (*Phytophthora*), crown and root rot occurs worldwide on almost all fruit trees as well as many woody ornamentals. Visible symptoms include: slow growth,

sparse, yellowing foliage, small fruit, wilting in hot weather, or sudden plant death. The disease can be confirmed by using a knife to expose the inner bark of the root collar or large roots. Look for distinctive brown tissue (infected) in contrast to cream-colored tissue (healthy). The causal pathogen is present in most soils, but only causes infection under optimal circumstances—high soil moisture or standing water, and susceptible host tissue. Once trees are infected, there is no cure.

*Management:* Plant only in well-drained areas with good quality trees. Do not replant in areas where root and/or crown rot occurred previously. Phosphorous acid can be sprayed on adjacent trees to prevent disease formation.

## Fire Blight

*Hosts:* apple, pear



Pears, and some varieties of apples are very susceptible to this bacterium-caused disease. Blossoms, terminal twigs, and sometimes entire limbs or trees are killed. Blossom and shoot infections on apple are brown, and on pear, black. Infected leaves will characteristically remain on the tree after twig or limb death. The bacterium overwinters in sunken cankers, which begin to ooze in spring when temperatures warm. Environmental conditions favoring infection are rainy days during bloom, when mean temperature (average of daily maximum and minimum) exceeds 60° F. Rain, heavy dew, and insects spread oozing bacteria to flowers, where new infections occur. Succulent shoot growth is also

susceptible to infection, especially during a wounding event, such as a hail-storm. Infected twigs will wilt over at the tip, in the shape of a shepherd's crook.

*Management:* Most importantly, all infections (blossom or shoot infections and cankers) should be pruned out of the tree (in dry weather). The earlier new infections are removed, the better. Cut 12 inches below the canker into healthy wood to be certain that the bacteria are removed. Be sure to clean pruning tools after each cut using 10% bleach solution or a 70% alcohol solution. Clean and oil tools when done. Do not prune during moist conditions, as this can contribute to disease spread. Protect flowers from infection with an antibiotic (streptomycin) or fixed copper just before a potential wetting event. For weather or spray timing updates, check with your local Extension agent and the [Tree Fruit Advisories](#) posted on the Utah IPM website.

## Gray Mold

*Hosts:* variety

Gray mold is caused by the fungus *Botrytis*, and infects flowers or fruits of strawberries, stone fruits, and grapes. High humidity, poor air movement, rain, or sprinkler irrigation favor the development of a disease. See management for “blossom blight.”

## Gummosis

*Hosts:* stone fruits

Gummosis is a general term describing the prolific oozing of clear sap from a tree. Gumming is produced in response to a variety of conditions, including insects, diseases, and wounding, and is most common on peach and sweet cherry. It can also be a response to poor growing conditions, such as compacted soil. To most accurately identify the cause of gummosis, consult your local Extension agent.

## Peach Leaf Curl

*Hosts:* peach, nectarine

This fungal disease is rare in Utah as it requires a long wet spring for development. Symptoms appear as puckered red lesions on new foliage that soon becomes green to tan. These leaves eventually turn brown and drop. New growth is usually healthy.



**Management:** Once you see the disease, there is nothing you can do. Wait until leaf-drop in the fall, and apply copper or lime-sulfur. Prevent irrigation water from wetting leaves.



### Perennial Canker

**Hosts:** peach, cherry, apricot, plum

Also called cytospora canker, die back, and sometimes gummosis, perennial canker is caused by a fungus that also attacks many ornamentals. Cankers are areas of dead tissue on stems, limbs, and twigs that are off-color, usually oval-shaped, and usually slightly sunken. Light amber gum may exude from the canker edges. They enlarge yearly or advance down side branches. If the outer bark is removed, a distinct line of demarcation can be seen between diseased (brown) tissue and healthy (cream colored) tissue. Spores spread this fungus during wet weather, and successful infections occur in weak or wounded tissue.

**Management:** A healthy, vigorous tree resists infection. Water, fertilize, and prune dead branches by cutting at least 4 inches below diseased wood. Remove abandoned trees or orchards. Avoid injury to trees. Control twig and tree borers since their damage may allow entrance of the fungus.

### Powdery Mildew

**Hosts:** apple, cherry, peach, nectarine, berries, grape



This fungus attacks leaves, flowers, and fruit, causing yellowing, distortion, stunting, russeted fruit, and reduced yield. The most noticeable sign is a white powdery residue, which is a mixture of the fungal mycelium and spores. Certain apple varieties (Jonathan, Idared, Gala, Jonagold, Winesap, Rome) and many cherries are commonly attacked but others may also be affected in

years of moisture and humidity. Infections begin in late spring, during warm days, cool nights, and some form of moisture. The spores are spread by wind, dripping dew, rain, and irrigation.



**Management:** Most trees can tolerate light infections. Rake and remove all leaves and debris in fall (not as important for apple, as the fungus survives the winter on living twigs). Fungicides work as a preventive, and must be applied prior to infections. They will not “cure” infected tissue. Pruning affected twigs may also be helpful. Plant fruit varieties resistant to powdery mildew.

### Root Rot

See [Crown Rot](#)

### Shot-hole Blight

See [Coryneum Blight](#)

### Strawberry Blossom Blight

See [Blossom Blight](#) and [Gray Mold](#)

### Sunburn of Fruit

**Hosts:** all varieties

Sunburn of fruit can be common in Utah, but is easily prevented with proper pruning and training. As fruit is exposed to excessive hot sun, the skin can turn brown or black. Severe sunburn can often cause a surface crack.

**Management:** Do not prune in late summer before harvest. Apply kaolin clay (a white, non-toxic clay mineral) in late season.

## Arthropods

(listed in alphabetical order)

### Aphids

**Hosts:** pome and stone fruits, nut trees



Many species of aphids feed on leaves of fruit trees. Rosy apple aphid will feed on apple fruits causing deformities and woolly apple aphid feeds on limbs and roots causing galls. All aphids suck sap from the phloem vessels and reduce tree vigor. Watch for curled and sticky leaves due to honeydew excreted by the aphids. Black sooty mold may grow on the honeydew staining leaves and fruits. Ants may climb into trees to collect the sweet honeydew and can indicate an aphid infestation. Aphids are small, soft-

bodied insects of numerous colors (e.g., green, red, brown, black) and often occur in clusters. Numerous beneficial insects (e.g., lady beetles, lacewings, and syrphid flies) help suppress aphid populations, so conserve and protect these natural enemies. The home orchardist can usually ignore aphid infestations unless the populations are extremely high, growth of young trees is being stunted, or black sooty mold is staining the fruit.

### Cat-facing Insects

*Hosts:* pome and stone fruits



True bugs that possess piercing-sucking mouthparts: lygus bug, stink bug, and boxelder bug. They can feed on young fruits and cause depressions in the fruits by killing plant cells. These dead cells cause indentations and distortions in fruit shape. The symptoms are called "cat-facing" because the scarring may look like a cat's face with puckered cheeks. Boxelder bugs primarily feed on fruits as they near maturity. Injury near harvest causes pits and sunken areas on fruits and lowers fruit quality and storability.

### Codling Moth

*Hosts:* apple and pear

Codling moths are the adults of the common "worms" that infest apples and pears. These moths emerge from overwintering sites in the spring and lay their eggs on and near developing fruits. The



key to successful management by the home orchardist is a combination of cultural practices (sanitation, trunk banding, and/or fruit bagging) (see page 5) and accurately timed insecticide sprays. Codling moth activity is strongly regulated by temperature and timing of sprays varies from year to year. To find out when codling moth is active in an area of the state and for spray timing recommendations, contact a lo-

cal county Extension agent and check the [Tree Fruit Advisories](#) posted on the Utah IPM website. Also, see the [Codling Moth Fact Sheet](#) posted on the Utah Pests website.

### Earwigs

*Hosts:* all, but especially stone fruits and berries

The European earwig is not native to North America and has become a pest in the arid western regions. Earwigs will climb the trunk or stem and chew into fruits as they near maturity. They are especially fond of peaches, nectarines, apricots, and berries. They often gain entry by wounds or openings, such as split-pits in peaches. They seek tight hiding spaces. They can also be predators on other insects, so their presence at times other than when fruits are ripe can be beneficial.



### Flatheaded Borers

*Hosts:* apple, cherry and plum

The flatheaded appletree and pacific flatheaded borers are usually only a problem under drought conditions and when populations are high in an area, such as when infested wood is stacked for firewood. The larvae girdle trunks and can kill young and stressed trees and those in decline. The adult beetles are active in June and July and lay eggs on the trunks of stressed trees. The key to management is to prevent larvae from tunneling into tree trunks. In addition to keeping trees healthy, apply protective trunk sprays or systemic soil insecticide treatments.



### Leaf Blister Mites

*Hosts:* pome fruits

Leaf blister mites are tiny mites (too small to see without the aid of a microscope) in the eriophyid group. They burrow under the lower surface of leaves and



cause “blisters” that are originally green and then turn brown as they age. Adults overwinter under leaf bud scales and emerge with new leaf growth in the spring. Very high populations can reduce photosynthesis and thus, tree vigor. Lower populations can be tolerated.

### Leafhoppers

*Hosts:* apple and grape



The white apple leafhopper, rose leafhopper, and grape leafhopper suck leaf sap reducing plant vigor and sometimes spotting fruit with excrement (called “tar spots”). The flying adults can also be a nuisance to fruit pickers when present in high numbers in the late summer to early fall. The adults are wedge-shaped with wings meeting in a sharp peak over the back. Best control is achieved when leafhoppers are still in the immature stage (nymphs). Nymphs feed on the undersides of leaves. If a population is high, treat before older nymphs (larger nymphs with longer wing pads) are present.

### Leafrollers

*Hosts:* variety



A caterpillar or pupa inside a folded leaf tied with silk is most likely a leafroller. Leafrollers are members of the moth group. The larvae (caterpillars) will

chew holes in leaves and in some cases, in developing fruit. Their populations are often suppressed by insecticides applied to control codling moth or other caterpillar pests. Microbial insecticides, such as Bt and spinosad, are very effective in killing leafrollers.

### Peach Silver Mite

*Hosts:* peach and nectarine

These tiny mites (too small to be seen without the aid of a microscope) cause stippling and upward

curling of leaves.

They are eriophyid mites and related to leaf blister and rust mites. Peach varieties with glands that secrete a sticky material over their new leaves are less



susceptible when the leaves are young. After gland secretions halt and in glandless varieties, leaves are susceptible to mite feeding. Heavy feeding causes “silvery” of leaves. Severe symptoms may include tree stress, reduced fruit size, and premature fruit drop.

### Peach Twig Borer

*Hosts:* apricot, peach, and nectarine



Chocolate brown larvae emerge from overwintering cells on the limbs of trees and tunnel into new succulent leaf shoot tips. Infested twigs die back and small masses of gum exude from tunnel openings. A second generation of these “worms” enters fruit during the summer once succulent shoot growth has ceased. Larvae typically enter fruit near the stem end and where fruits press against twigs. In home orchards, injury may not be severe enough to require treatment every year. Twig borer activity is strongly regulated by temperature and timing varies from year to year. To find out when peach twig borer is active in an area of the state and for spray timing recommendations, contact a local county Extension agent and check the [Tree Fruit Advisories](#) posted on the Utah IPM website. Also, see the [Peach Twig Borer Fact Sheet](#) posted on the Utah Pests website.

### Peachtree (Crown) Borer

*Hosts:* apricot, nectarine, peach, and plum



This insect is a clear-wing moth and the larvae tunnel in the cambium, just below the bark, typically at the soil-line of the trunk. They can be difficult to control because of the

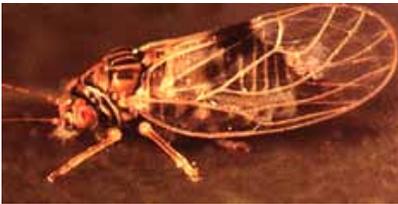


protection given them once they have entered the tree. Home orchardists should look carefully for round holes near the soil-line and oozing tree sap (shown above). Other problems cause gumming, so scrape off sap to

look for a hole underneath to confirm presence of a peachtree borer larva. Adult moths begin activity in late June and once mated, females lay their eggs on the base of tree trunks. Trees may be girdled and die due to borer injury. Preventive trunk sprays are the main control tactic.

### Pear Psylla

*Host:* pear



The adults resemble small cicadas. They overwinter outside of the orchard and return to pear trees in the early spring to lay eggs on buds and twigs. The nymphs can secrete copious sticky honeydew as they suck sap from the leaves and fruit. Black sooty mold may grow on the sweet honeydew causing staining of fruit. Leaf drop and decreased fruit yields may occur with heavy infestations. Pear psylla may also transmit a disease called “pear decline” that can slowly kill trees over a number of years. Root stocks resistant to pear decline are available. Look for psylla adults early in the spring (starting 6 weeks before bloom) by tapping or shaking the branches over a light colored pan. Resistance to many insecticides has occurred in pear psylla populations, so switching insecticides across years can help prevent resistance in your orchard. The best control is achieved with a dormant spray to kill overwintered adults before new eggs are laid.

### Pear Sawfly (Pear or Cherry Slug)

*Hosts:* cherry, pear, plum

The sawfly’s larvae have a slug-like appearance and feed on the upper surface of the leaf epidermis. They cause a skeletonizing injury where membra-



nous “windows” of leaf tissue remain in between leaf veins. The larvae are often suppressed by insecticides applied for other pests. Trees can tolerate low populations. Mechanical removal of larvae if numbers are low may be effective.

### Raspberry Crown Borer

*Hosts:* raspberry and blackberry

Female clearwing moths lay eggs on the undersides of leaves in the late summer to early fall. Larvae crawl down the outside of canes and tunnel into the crown to spend



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the winter. Larvae feed inside canes the following year. This insect has a 2-year life cycle. Dig out and dispose of infested canes. Treat lower canes and drench insecticide around the base of plants in late summer to early fall to kill larvae before they burrow into crowns.

### Raspberry Horntail

*Hosts:* raspberry and blackberry



The raspberry horntail is a member of the stem sawfly family. Adult female wasps insert eggs under the epidermis of canes, beginning before bloom. Larvae tunnel upward to the

cane tip. Prune canes 2 to 3 inches below the wilted area throughout the summer to remove the insect. Protect canes from egg-laying females by applying insecticides pre-bloom.

### Root Borers

*Hosts:* most fruit trees



Prionus root borer and ten-lined June beetle grubs feed on roots and crowns and cause tree decline. Soil application of a systemic insecticide may be an effective treatment. Currently,

imidacloprid (systemic) is only labeled on apple and pear. Check the insecticide label to be sure the fruit

crop is listed before use. Entomopathogenic nematodes and fungus can be effective on June beetle larvae.



### Root Weevils

*Hosts:* strawberry and stone fruits, especially

The adults are very hard, rounded beetles with pronounced “snouts.” Adults chew notches into leaf edges causing “scallop-ing.” Adults are primarily active at night. The larvae



feed on roots and crowns and are small, white and legless grubs. The best timing for suppression is in the spring and early summer when leaf-notching injury first appears and again in the late summer to early fall to target larvae before winter. Entomopathogenic nematodes and fungus applied to the soil by the roots can kill larvae.

### Rose Stem Girdler

*Hosts:* raspberry, blackberry, rose and other cane plants

The rose stem girdler is a flatheaded beetle, the larva of which burrows in berry canes. The larva has two small spines at the tip of its abdomen. The adult beetles fly in the spring and



females lay eggs on the canes. Larvae chew through the bottoms of eggs into canes. Larvae feed in a spiral pattern around the cambium (under the bark) and girdle canes. They form a swollen, gall-like area. The upper portions of canes are killed and break off easily during the summer. Protect canes from egg-laying females with an insecticide spray just after bloom. Consistent pruning out of dead and dying canes can be effective.

### Rust Mites

*Hosts:* many fruits

Rust mites are tiny mites (too small to see without the aid of a microscope) in the eriophyid group. Their feeding causes a russetting effect on leaves and fruit. Adults overwinter under leaf bud scales and emerge with new leaf growth in the spring. Pear leaves are sensitive to rust mites, and rust symptoms can be severe. In apple, rust mites can be beneficial in that they may serve as alternative prey for predatory mites that also help suppress spider mites. Very high populations of rust mites can reduce photosynthesis and thus tree vigor. Lower populations can be tolerated.



### Scale (San Jose Scale)

*Hosts:* pome and stone fruit trees



San Jose scale is the most common scale insect to attack fruit trees. Look for limbs encrusted with small, circular, black and gray armored scales. Scales will also feed on fruit and when they fall off they leave small red

halos with white centers on apple and pear fruits. The soft body of the insect is hidden underneath an armored shield. It feeds on the sap within leaves, limbs, and fruits. Females produce young that crawl from under the mother scale before settling to feed. The “crawlers” are active in the late spring and can be monitored with sticky tape traps (place around limbs with sticky side out). Time control sprays with crawler activity. Adults are difficult to kill. Feeding can reduce tree vigor and blemish fruit. If heavy infestations are not controlled, a tree can be killed.

### Spider Mites

*Hosts:* all fruits



Mites are very small arthropods that are more closely related to ticks than insects. European red mite overwinters as red eggs on tree limbs and, if abundant, can cause feeding injury early



in the season. Two-spotted and McDaniel spider mites overwinter as adults at the base of trees and may become a problem during hot, dry conditions in the mid and late summer when they reproduce rapidly (1-2 weeks to complete a generation). They remove sap from leaves causing a stippling appearance. Severe feeding causes “mite burn.” Spider mites produce fine silk webbing that becomes apparent when populations are high.

In addition to plant-feeding mites, there are predatory mites that feed on spider mites. Predatory mites can provide effective biological control if they aren't harmed by pesticides. Low populations of spider mites can be ignored and are often kept in check by the predatory mites. Spider mite outbreaks often follow pesticide applications that upset the predator-prey balance. Washing down trees or plants with a stiff spray of water delivered by the hose or applying insecticidal soap or horticultural mineral oil every 5 to 7 days until mite densities decline can be effective. Avoid applying soaps or oils during the hot part of the day as some leaf burn may result.

### Tree and Root Borers

See [Flatheaded Borers](#) and [Root Borers](#)

### Walnut Husk Fly

*Hosts:* walnut, peach, and nectarine



The walnut husk fly is related to the western cherry fruit fly. The adults are about the size of a house fly and have patterned wings with an inverted “V” at the tip. It lays eggs in the husk of walnut after the husk has softened a bit. It will also lay its eggs in softening peach and nectarine fruits, especially where husk fly

numbers are elevated due to the presence of non-treated walnut trees. Larvae (maggots) feed within fruits. Adults can be monitored with Pherocon AM® (yellow sticky) traps. Treat by 7 to 10 days after the first adult flies are caught or beginning in late July.

### Western Cherry Fruit Fly

*Hosts:* cherry (sweet and tart)



Western cherry fruit fly larvae (maggots) are a common pest of cherries in northern and central Utah. Every cherry can be infested by a maggot if populations are high. The dark banding pattern on the wings of the cherry fruit fly is a malformed letter “F” with the cross-bar originating from the upper vertical bar rather than the upright bar. Adults can be monitored with Pherocon AM® (yellow sticky) traps.

To prevent egg-laying in fruits, when fruits develop a rose blush color keep them protected with an effective insecticide through harvest. Read the insecticide label and follow the required pre-harvest wait period.

To find out when cherry fruit fly is active in an area of the state and for spray timing recommendations, contact a local county Extension agent and check the Tree Fruit Advisories posted on the [Utah IPM website](#). Also, see the [Western Cherry Fruit Fly Fact Sheet](#).

### Western Grape Leaf Skeletonizer

*Host:* grape



The insect is only known to be a problem in the St. George area of south-western Utah. The moth's larvae often feed side-by-side on the top and bottom surfaces of grape leaves. They can consume the entire

epidermal layer, leaving a thin membranous leaf and veins. If other grape pests are being controlled, the skeletonizer usually does not appear as a problem.

## Natural Enemies

(listed in alphabetical order)

### Lacewings



Lacewings are in a group of insects called neuropterans or “nerve winged” insects. The most common species are the green and brown lacewings. Adults have large membranous wings and are a common sight at porch lights on a warm evening. They lay their eggs on leaves with aphids and other small insects. The egg is born on a stalk so it is protected from predaceous insects, including other lacewings. Larvae look like little alligators with two siphoning mandibles sticking out in front. They suck the fluid out of their prey. They can be abundant and are effective predators of small insects, such as aphids.

### Lady Beetles

There are several common species of lady (or ladybird) beetles. This insect is also commonly called the “lady bug.” Both the adults and larvae are predaceous in their feeding habits. Many species feed exclusively on aphids. Adults are attracted to fly to trees and plants that have colonies of aphids. They will lay their eggs (small, oval and orange) within aphid colonies. When the larvae hatch they feed voraciously on the soft-bodied aphids. Larvae are elongated with an alligator appearance. Lady beetles can be an effective suppressor of aphid populations and eliminate the need for insecticide treatments.



### Mycorrhizal Fungi

There are several species of fungi that exist in healthy soils that form a symbiotic relationship, called a mycorrhiza, with living plants. Mycelium of mycorrhizal fungi envelop, or in some cases penetrate, tissue of the plant host’s root. The fungus absorbs carbohydrates from the plant, and in turn, the plant

gains a larger surface area from which to absorb soil nutrients. Plants grown with mycorrhizae are generally healthier, and can survive drought better, than those without. Most healthy soils will already contain species of mycorrhizal fungi, while yearly additions of organic matter or inoculation with purchased mycorrhizal fungi are necessary in poor soils.

### Parasitic Wasps

Many wasp species are parasites of insect pests in



the orchard and garden. Most species are less than ¼ inch in length, but some are larger. Adult females lay their eggs in or on other insects. The larvae that hatch from the eggs feed within or on the insect host, killing it at some point (usually late in the development cycle). Usually only one parasite develops inside an insect host, but there are exceptions.

Aphids that have been parasitized are called “mummies” and appear as enlarged and darkened (or sometimes lighter in color) aphid bodies with a large hole in the back where the parasite emerged.

### Predatory Mites

The western predatory mite is one of the most common predaceous mites in Utah. It occurs naturally and if not eliminated by pesticides and encouraged by the presence of mite prey, it can provide a good level of biological control of plant-feeding mites. The adults overwinter at the base of trees and on surrounding ground cover. They will climb into trees and plants in the search of mite prey. They will feed on small mites such as rust mites as well as spider mites. They will even eat each other. They prefer to feed on species and life stages smaller than themselves, so spider mite eggs and larvae are the most common prey.



## Syrphid Flies



Syrphid fly adults are also called “hover flies.” Many species mimic bees and have a black and yellow striped pattern on their abdomen (lower body). The adults are attracted to abundant and good quality nectar and can be seen hovering at the flowers of wildflowers, herbs, and other plants in the garden. They lay their eggs (oblong and white) on leaves with aphid colonies or other small insects. Larvae are predaceous on small insects. The larvae look like maggots with a narrower head than body. Species with green or brown larvae are the most common. The larvae are a voracious predator of small insects.

## True Bugs



There are a variety of predaceous true bugs. Minute pirate bug, big-eyed bug, damsel bug, and assassin bug are some of the most common in the home orchard and garden. Most of them are small and so they tend to feed on small insects. Insect eggs and small larvae are their primary prey. Most of them are generalists in their feeding habits and so they roam looking for attractive prey.

## SUPPLIERS OF IPM PRODUCTS

The following is a partial list of companies that supply products for integrated pest management. Inclusion in the list is by no means an endorsement by USU Extension.

### **Arbico Organics**

(traps, lures, and organic supplies)

P.O. Box 8910  
Tucson, AZ 85738-0910  
1-800-827-2847

### **Biocontrol Network**

(beneficial insects, mites, nematodes and other bio-control and IPM materials including Bt products)

5116 Williamsburg Road  
Brentwood, TN 37027  
1-800-441-BUGS

### **Gardens Alive**

(biocontrol and monitoring materials, beneficial insects)

5100 Schenley Place  
Lawrenceburg, IN 47025  
1-513-354-1482

### **Gempler's**

(wide variety of horticultural products, traps, lures, control materials)

P.O. Box 44993  
Madison, WI 53744-4993  
1-800-382-8473.

### **Great Lakes IPM**

(wide variety of IPM products)

10220 Church Road  
Vestaburg, MI 48891-9746  
1-800-235-0285

### **Peaceful Valley Farm and Garden**

Supply (horticultural and organic products)

P.O. Box 2209  
125 Clydesdale Court  
Grass Valley, CA 95945  
1-888-784-1722

### **Raintree Nursery**

(apple bags, traps, and many other horticultural products)

391 Butts Road  
Morton, WA 98356  
1-360-496-6400

## PESTICIDES LISTED BY GENERIC AND BRAND NAMES

Chemical pesticide names have been used in this bulletin. The following list provides at least some of the trade or brand names that the product may bear. Be sure to check the active ingredients because some products have retained their trade name, but changed the ingredients. The product formulation you buy and use must be properly labeled for the crop you treat.

**B = bactericide, F = fungicide, I = insecticide, and M = miticide**

### **Acetamiprid:**

Ortho Flower, Fruit and Veg. (variety of chemical families; caution label) **I**

### **Azadirachtin:**

AZA-Direct, Bioneem, Azatin, Align (botanical; caution label) **I**

### **Bacillus thuringiensis (Bt):**

Dipel, Thuricide, Worm Ender, Caterpillar Killer; all kill caterpillar insects by acting as a stomach poison; good coverage of foliage is required to be effective (biological; caution label) **I**

### **Bifenthrin:**

Ortho Max Lawn and Garden Insect Killer (of the fruit crops, only registered on pear and caneberry) **I**

### **Bordeaux mixture:**

Mixture of hydrated lime, copper sulfate, and water (inorganic; caution label) **F**

### **Captan:**

High Yield Captan, Gordons Fruit Tree Spray Bonide Complete Fruit Tree Spray (chlorinated dicarboximide; danger label) **F**

### **Carbaryl:**

Sevin, Bonide Tree Fruit Spray (carbamate; caution or warning label) **I**

### **Chlorothalonil:**

Fertilome Landscape and Garden, Daconil/Ortho Max Garden Disease Control, Bonide Fungonil; do not use after shuck split **F**

### **Codling moth virus:**

CydX, Virosoft, Carpovirusine - purchase online (biological; caution label) **I**

### **Copper:**

Lilly Miller Kop-R-Spray, Liqui-Cop (inorganic derivatives; caution label). **F**

### **Entomopathogenic fungus:**

Botanigard, Naturalis (*Beauveria bassiana*); living micro-organism (biological; caution label) **I**

### **Entomopathogenic nematodes:**

Scanmask (*Steinernema carpocapsae*), Cruiser (*Heterorhabditis bacteriophora*); living microorganisms (biological; caution label) **I**

### **Gamma-cyhalothrin:**

Spectracide, all fruit trees; wait 21 days after last spray to harvest apple, pear; wait 14 days for all others (pyrethroid; caution label) **I**

### **Horticultural mineral oil:**

SunSpray, Ultrafine, Orchex, Bonide All Season Spray Oil, Ortho Volck, High Yield Dormant Spray, Fertilome Scalecide ("horticultural oil" and "dormant oil" are both petroleum oil; use higher rate for dormant timing, lower rate for in-season sprays) (petroleum oil; caution label) **I, M**

### **Imidacloprid:**

Bayer Advanced Garden Tree and Shrub Insect Control (apple and pear only), Bayer Advanced Fruit, Citrus, and Vegetable Insect Control, Ortho Max Tree and Shrub Insect Control, Bonide Systemic Insect Spray (neonicotinoid; caution label) **I**

### **Insecticidal soap:**

Safer Insecticidal Soap, Ortho Ecosense, Natural Guard Insecticide Soap, M-Pede; harmless to humans, but capable of burning plant foliage; requires full coverage to be effective and should be applied when temperatures are < 80°F (salts of fatty acids; caution label) **I, M**

### **Kaolin clay:**

Surround (inorganic; caution label) **F, I, M**

### **Malathion:**

Ortho Max Malathion, High Yield Malathion, Malathion (organophosphate; caution label) **I**

### **Neem oil:**

Garden Safe Fungicide, Green Light Neem, Fertilome Triple Action Plus (botanical, clarified hydrophobic neem oil; caution label) **F, I, M**

**Permethrin:**

Ortho Basic Solutions, Green Light Conquest, Bonide Borer-Miner Killer, Bonide Eight - not on apples after petal fall, not on cherries (pyrethroid; caution label) **I**

**Phosphorous Acid:**

Monterey Agri-fos (mono- and d-potassium salts of phosphorous acid)

**Potassium bicarbonate:**

Eco-Mate Armicarb "O" (inorganic; caution label) **F**

**Propiconazole:**

Fertilome, Liquid Systemic Fungicide - not on apple (caution or warning label) **F**

**Pyrethrin:**

Pyrellin, Bug Buster-O, Green Light Fruit Tree Spray, Spectracide Garden Insect Killer (botanical; caution label) **I**

**Pyrethrum:**

Pyganic (botanical; caution label) **I**

**Spinosad:**

Bonide Captain Jack, Monterey Garden Insect Spray, GF-120 NF for western cherry fruit fly, apple maggot, and walnut husk fly; products include bait + low rate of insecticide (biological; caution label) **I**

**Sticky Adhesive:**

Tangletrap, Tanglefoot (oil-based adhesive) **I, M**

**Streptomycin:**

Fertilome Fire Blight Spray, Plantomycin (antibiotic; caution label) **B**

**Sulfur/Lime Sulfur:**

Lily Miller Polysul, Bonide-lime Sulfur, Elemental Sulfur, Wettable Sulfur, Dusting Sulfur, Lime Sulfur, Elemental sulfur mixed with wetting and emulsifying agents to enhance solution in water (wetable sulfur) or mixed with 1 to 5% clay or talc to improve flow and dusting properties (dusting sulfur) (inorganic; caution label) **F, M**

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